The goal of probabilistic tractography is to obtain a connectivity index along with a white matter pathway that reflects fiber organization and is sensitive to pathological abnormalities contributing to disability.

Krishna et al., prospectively assessed the outcomes of Focused ultrasound thalamotomy (FUS-T) in 10 essential tremor (ET) patients using tractography-based targeting of the ventral intermediate nucleus (VIM).

VIM was identified at the intercommissural plane based on its neighboring tracts: the pyramidal tract and medial lemniscus. FUS-T was performed at the center of tractography-defined VIM. Tremor outcomes, at baseline and 3 months, were assessed independently by the Tremor Research Group. They analyzed targeting coordinates, clinical outcomes, and adverse events. The FUS-T lesion location was analyzed in relation to unbiased thalamic parcellation using probabilistic tractography. Quantitative diffusion weighted imaging changes were also studied in fiber tracts of interest.

The tractography coordinates were more anterior than the standard. Intraoperatively, therapeutic sonications at the tractography target improved tremor (>50% improvement) without motor or sensory side effects. Sustained improvement in tremor was observed at 3 mo (tremor score: 18.3 ± 6.9 vs 8.1 ± 4.4, P = .001). No motor weakness and sensory deficits after FUS-T were observed during 6-mo follow-up. Ataxia was observed in 3 patients. FUS-T lesions overlapped with the VIM parcellated with probablisitic tractography. Significant microstructural changes were observed in the white matter connecting VIM with cerebellum and motor cortex.

This is the first report of prospective VIM targeting with tractography for FUS-T. These results suggest that tractography-guided targeting is safe and has satisfactory short-term clinical outcomes [1].

1)
Krishna V, Sammartino F, Agrawal P, Changizi BK, Bourekas E, Knopp MV, Rezai A. Prospective Tractography-Based Targeting for Improved Safety of Focused Ultrasound Thalamotomy. Neurosurgery. 2019 Jan 1;84(1):160-168. doi: 10.1093/neuros/nyy020. PubMed PMID: 29579287.